

WHAT IS CLAIMED IS:

1. A control apparatus of an internal combustion engine comprising:

a brake booster for increasing a brake force of a  
5 brake by using a negative pressure of an intake pipe employed in the internal combustion engine; and

an ignition retarding control means for executing ignition retarding control to retard an ignition timing at a cold start in order to promote an operation to heat a  
10 catalyst for cleaning exhausted gas,

the control apparatus further comprising a negative pressure recognizing means for recognizing a negative pressure of the intake pipe or a negative pressure of the brake booster,

15 wherein the ignition retarding control means starts the ignition retarding control after a negative pressure recognized by the negative pressure recognizing means decreases to a value equal to or lower than a predetermined value.

20 2. A control apparatus of an internal combustion engine comprising:

a brake booster for increasing a brake force of a brake by using a negative pressure of an intake pipe  
25 employed in the internal combustion engine; and

an ignition retarding control means for executing ignition retarding control to retard an ignition timing at

a cold start in order to promote an operation to heat a catalyst for cleaning exhausted gas,

wherein the ignition retarding control means starts the ignition retarding control after a  
5 predetermined time lapses since a start.

3. A control apparatus of an internal combustion engine comprising:

a brake booster for increasing a brake force of a  
10 brake by using a negative pressure of an intake pipe employed in the internal combustion engine; and

an ignition retarding control means for executing ignition retarding control to retard an ignition timing at a cold start in order to promote an operation to heat a  
15 catalyst for cleaning exhausted gas,

the control apparatus further comprising a negative pressure recognizing means for recognizing a negative pressure of the intake pipe or a negative pressure of the brake booster,

20 wherein the ignition retarding control means reduces a retardation speed of the ignition timing till a negative pressure recognized by the negative pressure recognizing means decreases to a value equal to or lower than a predetermined value and, thereafter, increases the  
25 retardation speed.

4. A control apparatus of an internal combustion

engine comprising:

a brake booster for increasing a brake force of a brake by using a negative pressure of an intake pipe employed in the internal combustion engine; and

5 an ignition retarding control means for executing ignition retarding control to retard an ignition timing at a cold start in order to promote an operation to heat a catalyst for cleaning exhausted gas,

10 wherein the ignition retarding control means reduces a retardation speed of the ignition timing till a predetermined time lapses since a start and, thereafter, increases the retardation speed.

15 5. A control apparatus of an internal combustion engine comprising:

a brake booster for increasing a brake force of a brake by using a negative pressure of an intake pipe employed in the internal combustion engine; and

20 an ignition retarding control means for executing ignition retarding control to retard an ignition timing at a cold start in order to promote an operation to heat a catalyst for cleaning exhausted gas,

25 the control apparatus further comprising a negative pressure recognizing means for recognizing a negative pressure of the intake pipe or a negative pressure of the brake booster,

wherein the ignition retarding control means sets

the ignition timing's retardation quantity and/or retardation speed on the basis of a negative pressure recognized by the negative pressure recognizing means.

5           6. The control apparatus of an internal combustion engine according to claim 5, wherein the ignition retarding control means sets the ignition timing's retardation quantity and/or retardation speed on the basis of a sum of differences between negative  
10 pressures recognized by the negative pressure recognizing means and a predetermined value or a maximum value of the differences.

15           7. A control apparatus of an internal combustion engine comprising:

          a brake booster for increasing a brake force of a brake by using a negative pressure of an intake pipe employed in the internal combustion engine; and

20           an ignition retarding control means for executing ignition retarding control to retard an ignition timing at a cold start in order to promote an operation to heat a catalyst for cleaning exhausted gas,

25           wherein the ignition retarding control means sets the ignition timing's retardation quantity and/or retardation speed on the basis of a time lapsing since a start in the course of the ignition retarding control.

8. A control apparatus of an internal combustion engine comprising:

a brake booster for increasing a brake force of a brake by using a negative pressure of an intake pipe employed in the internal combustion engine; and

an ignition retarding control means for executing ignition retarding control to retard an ignition timing at a cold start in order to promote an operation to heat a catalyst for cleaning exhausted gas,

the control apparatus comprising:

a negative pressure recognizing means for recognizing a negative pressure of the intake pipe or a negative pressure of the brake booster; and

a retardation quantity control means for changing a control range of a retardation quantity of the ignition timing in accordance with a negative pressure recognized by the negative pressure recognizing means and/or a load borne by the internal combustion engine.

9. A control apparatus of an internal combustion engine comprising:

a brake booster for increasing a brake force of a brake by using a negative pressure of an intake pipe employed in the internal combustion engine; and

an ignition retarding control means for executing ignition retarding control to retard an ignition timing at a cold start in order to promote an operation to heat a

catalyst for cleaning exhausted gas,

the control apparatus further comprising a negative pressure recognizing means for recognizing a negative pressure of the intake pipe or a negative pressure of the brake booster,

wherein the ignition retarding control means further retards the ignition timing if a predetermined time has lapsed since a start, the internal combustion engine is in an idle operation state and a negative pressure recognized by the negative pressure recognizing means is equal to or lower than a predetermined value.

10. The control apparatus of an internal combustion engine according to claim 1, wherein the negative pressure recognizing means is a pressure sensor for detecting a negative pressure of the brake booster.

11. The control apparatus of an internal combustion engine according to claim 1, wherein the negative pressure recognizing means estimates a negative pressure of the brake booster on the basis of an operating condition of the internal combustion engine.

12. A valve timing control apparatus of an internal combustion engine comprising

a variable intake valve timing mechanism for varying an intake valve's position relative to a crank

shaft of the internal combustion engine and used for controlling a closing position of the intake valve on the basis a result of processing carried out on the closing position of the intake valve in accordance with an  
5 operating condition of the internal combustion engine,

the valve timing control apparatus further comprising a first advancing control means, which is used for advancing the closing position of the intake valve on the basis of operating status of a brake when the closing  
10 position of the intake valve is retarded behind a bottom dead center.

13. A valve timing control apparatus of an internal combustion engine comprising:

15 a target revolution speed setting means for setting a target revolution speed of the internal combustion engine;

an intake airflow control means, which is used for controlling a revolution speed of the internal  
20 combustion engine by setting a throttle valve at a position on an open side to increase an intake airflow when the revolution speed decreases so that the revolution speed is restored to the target revolution speed;

a catalyst converter provided on an exhaust pipe;

25 an ignition timing control means for controlling an ignition timing in accordance with an operating state of the internal combustion engine; and

a variable intake valve timing mechanism for variably setting an intake valve's position relative to a crank shaft of the internal combustion engine,

the valve timing control apparatus used for controlling a closing position of the intake valve on the basis a result of processing carried out on the closing position of the intake valve in accordance with an operating condition of the internal combustion engine,

wherein:

the ignition timing control means has a means for retarding the ignition timing behind an ignition timing set on the basis of a normal operating condition in order to raise the temperature of the catalyst converter at an early time at a cold start of the internal combustion engine; and

the valve timing control apparatus further has a first advancing control means, which is used for advancing the closing position of the intake valve on the basis of operating status of a brake when the closing position of the intake valve is retarded behind a bottom dead center.

14. The valve timing control apparatus of an internal combustion engine according to claim 13, wherein the first advancing control means sets an advancing quantity of the closing position of the intake valve on the basis of an ignition timing set by the ignition timing control means or a retardation quantity by which the



ignition timing has been retarded.

15. The valve timing control apparatus of an internal combustion engine according to claim 12, wherein  
5 the first advancing control means advances a closing position of the intake valve on the basis of operation status of the brake when the intake pipe's pressure detected by a pressure detecting means is on the positive side relative to a predetermined negative pressure.

10  
16. The valve timing control apparatus of an internal combustion engine according to claim 15, wherein the first advancing control means sets an advancing quantity of a closing position of the intake valve on the  
15 basis of the intake pipe's pressure detected by the pressure detecting means.

17. The valve timing control apparatus of an internal combustion engine according to claim 12, wherein  
20 the first advancing control means carries out an operation to advance a closing position of the intake valve when the brake is turned on and ends the operation to advance a closing position of the intake valve after a predetermined time lapses since the brake is turned off.

25  
18. The valve timing control apparatus of an internal combustion engine according to claim 12, wherein

the first advancing control means advances a closing position of the intake valve till a piston provided on the internal combustion engine reaches a position in close proximity to a bottom dead center.

5

19. The valve timing control apparatus of an internal combustion engine according to claim 12, wherein the first advancing control means advances a closing position of the intake valve so that a period of time during which both an exhaust valve and the intake valve are open simultaneously becomes equal to or shorter than a predetermined period of time.

20. The valve timing control apparatus of an internal combustion engine according to claim 12, wherein the first advancing control means advances a closing position of the intake valve on the basis of status of the brake when a predetermined condition is satisfied.

21. The valve timing control apparatus of an internal combustion engine according to claim 20,

the valve timing control apparatus further comprising a revolution speed detecting means for detecting a revolution speed of the internal combustion engine,

wherein the predetermined condition for advancing a closing position of the intake valve is considered to be

satisfied when a revolution speed detected by the revolution speed detecting means is equal to or lower than a predetermined revolution speed.

5           22. The valve timing control apparatus of an internal combustion engine according to claim 20,

the valve timing control apparatus further comprising:

10           an engine water temperature detecting means for detecting a temperature of cooling water of the internal combustion engine; and/or

an intake air temperature detecting means for detecting a temperature of intake air absorbed into a combustion chamber of the internal combustion engine,

15           wherein the predetermined condition is considered to be satisfied when the temperature of the cooling water is at least equal to a predetermined value and/or the temperature of the intake air is at least equal to another predetermined value.

20           23. The valve timing control apparatus of an internal combustion engine according to claim 13,

the valve timing control apparatus further comprising a second advancing control means, which is used  
25 for advancing a closing position of the intake valve till an operation to retard an ignition timing is carried out by the ignition timing control means.

24. The valve timing control apparatus of an internal combustion engine according to claim 12,

the valve timing control apparatus further  
5 comprising a combustion state detecting means for detecting a combustion state of the internal combustion engine,

wherein the first advancing control means advances a closing position of the intake valve on the  
10 basis of status of the brake when a combustion state detected by the combustion state detecting means is stable.

25. The valve timing control apparatus of an internal combustion engine according to claim 24, wherein  
15 the combustion state detecting means detects a combustion state of the internal combustion engine on the basis of variations in internal combustion engine speed or variations in internal combustion engine torque.

20 26. The valve timing control apparatus of an internal combustion engine according to claim 24,

the valve timing control apparatus further comprising a combustion stabilizing means, which is used for stabilizing combustion of the internal combustion  
25 engine when a combustion state detected by the combustion state detecting means is instable,

wherein the combustion stabilizing means has at

least one of the following means:

an air-fuel ratio weak rich control means for controlling an air-fuel ratio resulting from combustion of the internal combustion engine to a weak rich value;

5 an ignition timing advancing control means for advancing an ignition timing of the internal combustion engine by a predetermined quantity;

a retardation control means for executing control to retard a closing position of the intake valve; and

10 an intake valve lift quantity control means for executing control to increase a lift quantity of the intake valve.